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Two new rust species on *Fabaceae* from Brazil

Mauricio Salazar Yepes[1] & Anibal Alves de Carvalho Júnior[2*]

[1]*Universidad Nacional de Colombia, sede Medellín, Calle 59A, No. 63–20, Medellín, Colombia*
[2]*Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Pacheco Leão 915, CEP 22460-030, Rio de Janeiro, RJ, Brazil*

* Correspondence to: *anibal@jbrj.gov.br*

Abstract— Two new species of rust fungi (*Basidiomycota*, *Pucciniales*) on *Fabaceae* are proposed: *Atelocauda sakuraguiae* on *Ormosia* sp. and *Ravenelia costae* on *Pseudopiptadenia leptostachya*. Both were collected at the Parque Nacional do Itatiaia, Brazil. *Atelocauda sakuraguiae* can be distinguished from all other *Atelocauda* species on *Fabaceae* by its non-lobed aeciospores, septate aecial paraphyses, less elongate teliospores, and septate teliospore pedicels. *Ravenelia costae* can be distinguished from all other *Ravenelia* species by its smooth teliospores, probasidia deriving from germ pores, pendent cysts, echinulate urediniospores, and absence of paraphyses.

Key Words— Atlantic forest, biodiversity, phytopathology, plant disease, *Uredinales*

Introduction

Through a project supported by the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro entitled "Uredobiota (fungi) do Parque Nacional do Itatiaia," rust fungi specimens were collected in the States of Minas Gerais and Rio de Janeiro, Brazil. This field and laboratory work revealed two species with distinctive characteristics differing from other rust species on *Fabaceae* that are described here as new.

Materials & methods

The specimens were collected during 2006 and 2007 in the Parque Nacional do Itatiaia in the States of Minas Gerais and Rio de Janeiro, Brazil. Collections were slowly dried and accessioned into the Herbarium of the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro (RB). Sori were observed using a Leica S6E stereomicroscope. Free hand sections and scrapings were placed in lactophenol or chloral hydrate and then examined using a Zeiss Axioskop 40 compound microscope. For scanning electron microscopy (SEM) observation, material was mounted on a double-sided adhesive tape, fixed in osmium vapor for 17 h, gold-palladium coated with an Emitech K550X coater,

and observed with a Zeiss EV 550X SEM. Illustrations were created from images of these slides.

Taxonomy

Atelocauda sakuraguiae Salazar-Yepes & A.A. Carvalho, **sp. nov.** Figs 1–8

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Differs from all other *Atelocauda* species on *Fabaceae* by its non-lobed aeciospores, septate aecial paraphyses, less elongate teliospores, and septate teliospore pedicels.

Type: on *Ormosia* sp. (*Fabaceae*): Brazil, Minas Gerais, Parque Nacional do Itatiaia, Vale de Santa Clara Trail, 22°19′17.4″S 44°37′17.8″W, 1615 m asl, 11 Oct 2007, M. Salazar Yepes & A.A. Carvalho Jr. 638-07 (**Holotype**, RB480639).

Etymology: Dedicated to Cassia Mônica Sakuragui, a distinguished botanist and authority on *Araceae*.

Spermogonia few, amphigenous, mostly on adaxial leaf surface, Group VI (type 7). Aecia *Uredo*-type, few amphigenous, mostly on adaxial leaf surface, subcuticular, in groups, erumpent, cinnamon-brown. Paraphyses abundant, peripheral, incurved, flexuous, septate at base, 81–90 × 9–12 µm; wall smooth, colorless to pale yellow. Aeciospores obovoid to clavate, 27–30 × 21–27 µm; wall echinulate, 1.5–2 µm thick at sides, 2–3 µm thick at base, chestnut gold; germ pores obscure, one near the hilum. Telia on abaxial leaf surface, scattered, or in groups, minute, subcuticular in origin, becoming ruptured with conspicuous ruptured cuticle, pulverulent, chocolate-brown, with abundant peripheral paraphyses. Paraphyses cylindrical, flexuous, incurved, dichotomically and trichotomically branched, septate at base, 75–105 × 12–15 µm; wall smooth, mostly dorsally thickened up to 6 µm, and colorless to pale yellow. Teliospores obovoid to oblong-globoid, 24–33 × 24–30 µm; distal tubercles, 5 µm wide; wall uniformly 2–3 µm thick, cinnamon brown, tuberculate; germ pores one near the hilum; pedicel fragile, septate near the spore, ≤75 µm long, colorless.

Ecology — The rust infects *Ormosia* plants at altitudes above 1600 m above sea level (asl) in National Park of the Itatiaia, whose forest is designated as dense rainforest High Montana (Veloso et al. 1991).

Comments — Arthur & Cummins (1933) erected *Atelocauda* (with *A. incrustans* Arthur & Cummins as its type) differing from *Uromyces* by its type 7 spermogonia and from *Dicheirinia* and *Diabole* by its one-celled teliospores formed on pedicels. Thirumalachar & Kern (1955) reduced the genus to synonymy under *Pileolaria* and recombined its type as *P. incrustans*. Although Cummins (1959, 1978) accepted the placement in *Pileolaria*, Cummins & Hiratsuka (1983) resurrected *Atelocauda*, to which they transferred three *Uromyces* species on *Acacia* from Hawaii, Australia, and neighboring regions. Walker (2001), who re-circumscribed *Atelocauda*, transferred five species assigned to *Atelocauda* by Cummins & Hiratsuka (1983), Ono (1984), and

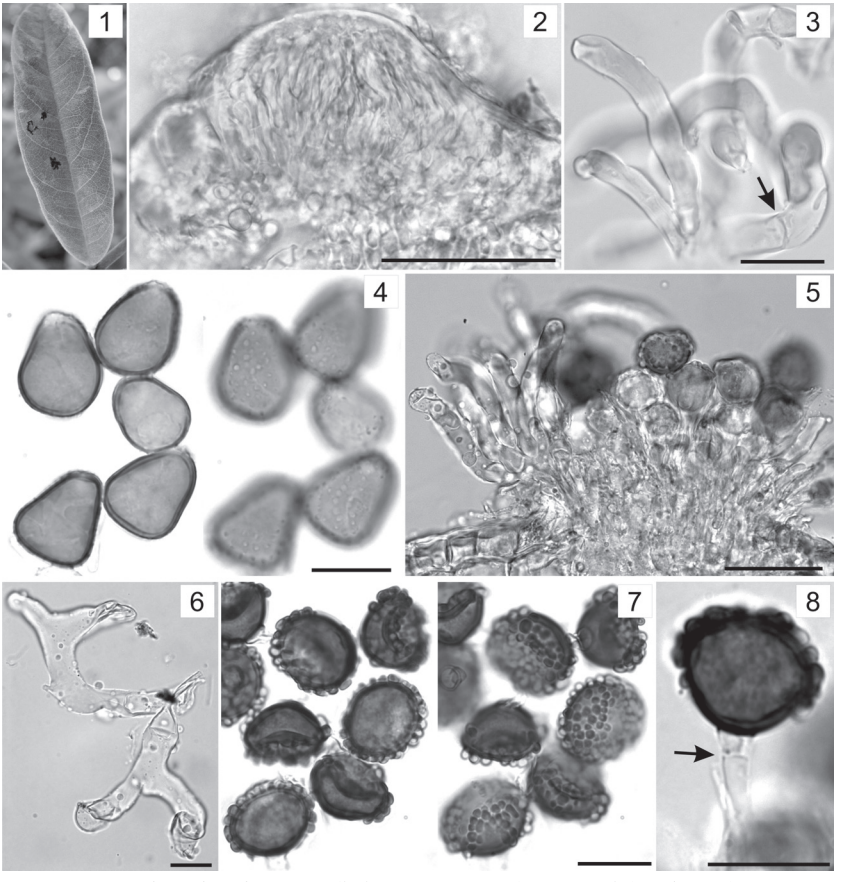

Figure 1–8. *Atelocauda sakuraguiae* (holotype, RB480639). 1. Aecial (*Uredo*-type) symptoms on adaxial leaf surface. 2. Section of spermogonium (type 7). 3. Flexuous paraphyses showing a septum (arrowed). 4. Aeciospores; left, median focus; right, surface focus. 5. Section of telial sorus, showing teliospores and paraphyses. 6. Dichotomous telial paraphyses. 7. Teliospores; left, median focus; right, surface focus. 8. Teliospores; pedicel septate near the spore (arrowed). Bars: 2, 5 = 50 µm; 3, 4, 7, 8 = 20 µm; 6 = 10 µm.

Gardner (1991) to a new genus *Racospermyces* and added a new species, *A. shivasii* J. Walker on *Ormosia* from Australia. Zhuang & Wei (2009) recombined *Uromyces ormosiae* L. Guo & Y.C. Wang on *Ormosia* spp. as *Atelocauda ormosiae*, based on its subcuticular spermogonia type 7.

Atelocauda shivasii, *A. incrustans*, and *A. ormosiae* differ from *A. sakuraguiae* by their lobed anamorph spores, their non-septate teliospore pedicels, and their more elongated teliospores (Arthur & Cummins 1933, Walker 2001, Zhuang & Wei 2009).

Walker (2001) also discovered spermogonia and *Uredo*-type aecia with lobed spores on the type specimen of *A. incrustans* and pointed out the morphological similarities between *Atelocauda shivasii* on *Ormosia* and *Dicheirinia ormosiae* (Arthur) Cummins, whose urediniospores are similar in shape with a basal germ pore associated with a smooth patch. Similarly *Atelocauda sakuraguiae* has *Uredo*-type aecia and aeciospores with a basal germ pore in a smooth area (Fig. 4). From these morphological similarities, it is assumed that *Atelocauda* is more closely related to *Raveneliaceae* than to *Pileolariaceae* (sensu Cummins & Hiratsuka 2003). Like Walker (2001), we consider *Atelocauda* to be closely related to *Ravenelia*, *Dicheirinia*, and other genera in *Raveneliaceae*.

Ravenelia costae Salazar-Yepes & A.A. Carvalho, **sp. nov.** Figs 9–14

Mycobank MB564579

Differs from all other *Ravenelia* species by its smooth teliospores, probasidial cells germinating by germ pores, pendent cysts, echinulate urediniospores, and absence of paraphyses.

Type: on *Pseudopiptadenia leptostachya* (Benth.) Rauschert (*Fabaceae*): Brazil, Rio de Janeiro, Itatiaia, Parque Nacional do Itatiaia, around the bridge over the Rio Campo Belo, 22°27′41.1″S 44°37′9.5″W, 1109 m asl, 6 Aug 2007, M. Salazar Yepes & A.A. Carvalho Jr. 469-07 (**Holotype**, RB532381).

Etymology: Dedicated to Denise Pinheiro da Costa, a distinguished botanist and authority on *Metzgeriaceae*, *Hepaticae*.

Spermogonia amphigenous, in groups on rounded necrotic lesions, 1–2 mm diam. Aecia dark cinnamon brown, on abaxial leaf surface, scattered, or in groups, peridiate, cupulate, white to pale yellow. Peridial cells irregular in shape, firmly united, 21–48 µm diam.; outer wall finely verrucose and inner wall verrucose-striate, colorless. Aeciospores obovoid to oblong-ellipsoid, polyhedric, 30–42 × 24–27 µm; wall verrucose, 1–2 µm thick, pale chestnut brown to colorless. Uredinia on abaxial leaf surface, scattered, or in small groups, minute, subepidermal in origin, ruptured epidermis conspicuous, pulverulent, cinnamon-brown; paraphyses absent. Urediniospores obovoid, pyriform, ellipsoid, 30–45 × 18–24 µm; wall echinulate, 1–2 µm thick at sides, 1–3 µm thick at apex, pale cinnamon-brown; germ pores obscure. Telia on abaxial leaf surface, scattered, or in small groups, subepidermal in origin, ruptured epidermis conspicuous, pulverulent, dark cinnamon brown; paraphyses absent. Teliospore heads 45–90 µm diam., 4–7 probasidial cells across, central cells 18–21 µm diam., variable in size and shape; wall smooth, 2–3 µm thick, cinnamon-brown; cysts colorless, globoid, pendent, 21–30 µm diam.; germ pores evident, 1 in each cell, 3–6 µm diam.; pedicel multi-hyphal, mostly persistent, ≤75 µm, hyaline.

Additional specimens examined: on *Pseudopiptadenia leptostachya*: **BRAZIL**, **Rio de Janeiro**, Itatiaia, Parque Nacional do Itatiaia, on the Véu de Noiva-Itaporani

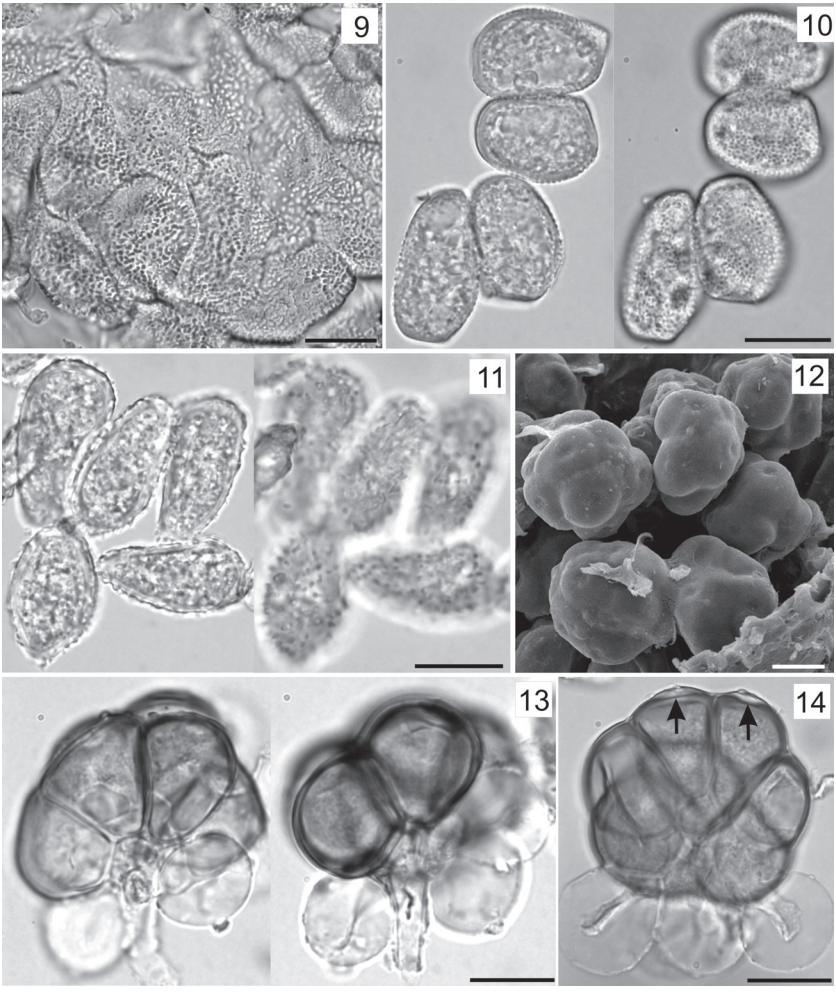

Figure 9–14. *Ravenelia costae* (holotype, RB532381). 9. Peridial cells. 10. Aeciospores; left, median focus; right, surface focus. 11. Urediniospores. Left, median focus; right surface focus. 12. Teliospores; upper view (SEM). 13. Teliospores; left, median focus; right, surface focus. 14. Teliospores; apical pores (arrowed). Bars = 20 μm.

Waterfalls Trail, 1180 m asl, 17 Aug 2006, M. Salazar Yepes, A.A. Carvalho Jr. & I. França 227-06 (RB480597); 23 Apr 2007, M. Salazar Yepes, A.A. Carvalho Jr. & F. Santoro 211-07 (RB480593); Rio Campo Belo-Prateleiras Trail, 22°25′44.8″S 44°37′37.6″W, 1400 m asl, 5 Dec 2006, M. Salazar Yepes & A.A. Carvalho Jr. 448-06 (RB480621); 22°26′7.3″S 44°37′32.5″W, 1265 m asl, 27 Apr 2007, M. Salazar Yepes, A.A. Carvalho Jr. & F. Santoro 355-07 (RB480612); around the Abrigo 10 (Lamedo), 22°25′34.4″S 44°37′54.1″W, 1500 m asl, 5 Dec 2007, M. Salazar Yepes & A.A. Carvalho Jr. 725-07 (RB480644).

Ecology — The rust-infected *P. leptostachya* plants are found at altitudes under 1500 m in National Park of the Itatiaia, whose forest is classified as dense rainforest Montana (Veloso et al. 1991).

Comments — *Pseudopiptadenia*, the host of our species, belongs to the Piptadenia group in the *Mimosoideae* subfamily of legumes. *Mimosoideae* hosts have at least 73 species of *Ravenelia*. From these, only seven have smooth teliospores and uredinia that (if present) lack paraphyses. *Ravenelia versatilis* (Peck) Dietel and *R. chacoensis* J.C. Lindq. differ from *R. costae* by their larger teliospores; *R. bahiensis* Henn., *R. hieronymi* Speg., and *R. entadae* Lagerh. & Dietel differ by their teliospores having germ slits, and *R. bahiensis* also differs by being microcyclic; *R. striatispora* Cummins & J.W. Baxter differs by its urediniospores having striate ornamentation; and *R. prosopidicola* J.C. Lindq. differs by its smaller aeciospores with 6–7 equatorial germ pores (Hennen et al. 2005, Resende 2007, and Hernandez et al. 2012).

After comparison with the most comprehensive recent literature, including Hennen et al. (2005), Resende (2007), and Hernandez et al. (2012), we determined that *R. costae* is unique among other *Ravenelia* by the combination of smooth teliospores, probasidial cells germinating by germ pores, pendent cysts, echinulate urediniospores, and uredinia without paraphyses.

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